



(12) **EUROPEAN PATENT APPLICATION**

(88) Date of publication A3:
14.07.2004 Bulletin 2004/29

(51) Int Cl.7: **G11C 11/56**, G11C 11/15

(43) Date of publication A2:
28.05.2003 Bulletin 2003/22

(21) Application number: **02258092.2**

(22) Date of filing: **25.11.2002**

(84) Designated Contracting States:
**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
IE IT LI LU MC NL PT SE SK TR**
Designated Extension States:
AL LT LV MK RO SI

(72) Inventors:
• **Sharma, Manish**
Mountain View CA 94043 (US)
• **Tran, Lung T.**
Saratoga CA 95070 (US)

(30) Priority: **26.11.2001 US 992426**

(74) Representative: **Powell, Stephen David et al**
WILLIAMS POWELL
Morley House
26-30 Holborn Viaduct
London EC1A 2BP (GB)

(71) Applicant: **Hewlett-Packard Company**
Palo Alto, CA 94304 (US)

(54) **Multibit memory device**

(57) A memory device (50) includes memory cells (130, 230) having re-writeable element (134, 234) and a write-once element (136, 236) in series with the re-writeable element (134, 234), the re-writeable element (134, 234) being programmable between a high resistance state and a low resistance state. The write-once element (136, 236) can be an anti-fuse element that is

programmable from a high resistance state to a low resistance state, or a fuse element that is programmable from a low resistance state to a high resistance state. The two possible states for the re-writeable element (134, 234) and the two possible states for the write-once element (136, 236) allow the memory cells (130, 230) to store four different bits.

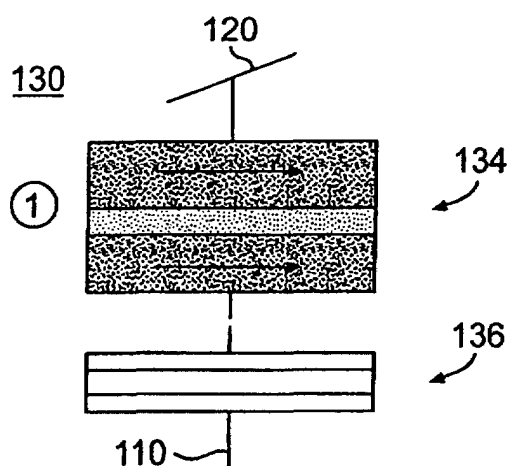


FIG. 5A

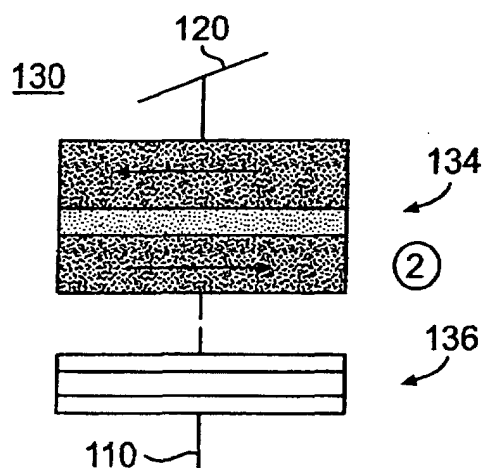


FIG. 5B

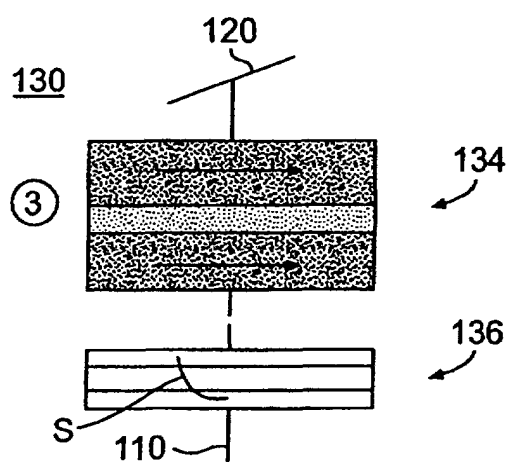


FIG. 5C

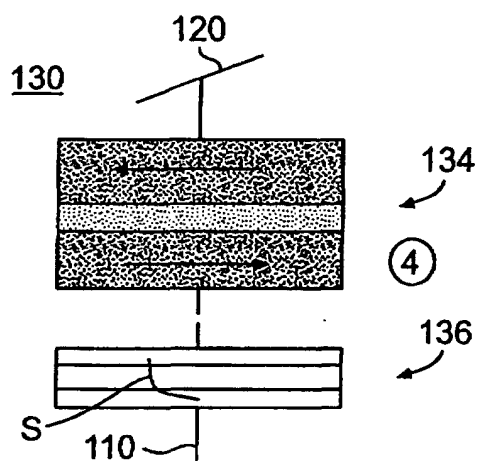


FIG. 5D



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 02 25 8092

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	US 6 269 018 B1 (MONSMA DOUWE JOHANNES ET AL) 31 July 2001 (2001-07-31) * column 4, line 14 - line 33 * * column 7, line 20 - line 26 * * claims 18-25 *	1,2,8-10	G11C11/56 G11C11/15
X	US 5 930 164 A (ZHU THEODORE) 27 July 1999 (1999-07-27) * column 2, line 32 - column 3, line 12 * * column 4, line 36 - line 56 * * column 5, line 1 - line 23 * * figures 1,3,4 *	1,2,8-10	
A	US 5 200 652 A (LEE ROGER R) 6 April 1993 (1993-04-06) * column 1, line 7 - column 2, line 65 * * figure 1 *	1-10	
A	US 2001/021124 A1 (MORITA KIYOYUKI ET AL) 13 September 2001 (2001-09-13) * paragraph [0007] - paragraph [0011] *	1-10	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			G11C
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 11 May 2004	Examiner Colling, P
<p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document</p>			

EPO FORM 1503 03/02 (P04001)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 02 25 8092

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

11-05-2004

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 6269018	B1	31-07-2001	NONE
US 5930164	A	27-07-1999	TW 457483 B 01-10-2001
US 5200652	A	06-04-1993	NONE
US 2001021124	A1	13-09-2001	CN 1346155 A 24-04-2002
		EP 1134743 A2 19-09-2001	
		JP 2002204006 A 19-07-2002	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82